

Interactional Empowerment

Kristina Höök, Anna Ståhl, Petra Sundström, Jarmo Laakso

Mobile Life center at Stockholm University

Forum 100

164 40 Kista

Sweden

{kia, petra}@dsv.su.se

Swedish Institute of Computer Science

Box 1263

164 29 Kista

Sweden

{annas}@sics.se

ABSTRACT

We propose that an *interactional* perspective on how emotion is constructed, shared and experienced, may be a good basis for designing affective interactional systems that do not infringe on privacy or autonomy, but instead empowers users. An interactional design perspective may make use of design elements such as open-ended, ambiguous, yet familiar, interaction surfaces that users may use as a basis to make sense of their own emotions and their communication with one-another. With such tools, users are provided with power over their own data and the interpretation of it – providing for privacy and autonomy. We describe the interactional view on design for emotional communication, and provide a set of orienting design concepts and methods for design and evaluation that help translate the interactional view into viable applications. From an embodied interaction theory perspective, we argue for a non-dualistic, non-reductionist perspective on affective interaction design.

Author Keywords

Affective Interaction, Emotional Computing, Social Factors, Interaction Design, Contextual Information

ACM Classification Keywords

H5.2, Classification, Information Interface and Presentation: User Interfaces

INTRODUCTION

Affective computing systems that make use of biosensors (measuring sweat, pulse and other autonomic reactions) typically try to identify users' emotions as discrete information units. In doing so the systems rely on what has been called the *informational view* [3, 4]. According to Boehner and colleagues, this is the predominant view in the affective computing area. Emotions in this view are seen as informational units that are internally constructed and then trans-

mitted. Interface paradigms based on the informational view focus on helping systems to better understand the signals that users are transmitting. Applications may isolate, measure, interact with and influence our emotions. This makes them potentially problematic from an ethical viewpoint as they may thereby infringe on values such as privacy or autonomy.

We wanted to explore whether we could start from a different perspective on emotions – the *interactional view* proposed by Boehner et al. [3]. An interactional view sees emotions as constructed in interaction, where the system supports people in understanding and experiencing their own emotions. An interactional perspective on design will not aim to detect a singular account of the “right” or “true” emotion of the user and tell them about it, but rather make emotional experiences available for reflection. That is, to create a representation that incorporates people's everyday experiences that they can later reflect on. Users' own, richer interpretation guarantees that it will be a more “true” account of what they are experiencing.

In here, we shall try to argue that this interactional view, when translated into design, has some power in preserving aspects of users' privacy and autonomy in interaction. Below we will first exemplify the informational view on design and discuss how it may infringe on privacy and autonomy. By introducing two systems that we have built, eMoto and Affective Diary, we will then show how privacy and autonomy can be enacted as an interpretative and negotiated activity using the interactional perspective on design.

The original description of the interactional view by Boehner et al is then fleshed out and slightly altered to incorporate even more of a non-reductionist and non-dualistic perspective. Lacking from the original description was a description of how our human, physical, bodies can be an arena for embodied experiences. In our view the integration of bodily, cognitive and social/cultural interactions into a design is key when dealing with design for emotional interaction. Emotions are not only cognitive phenomena, but are also experienced as physical, bodily processes, and are in turn influenced by our bodily experiences [7, 6]. The way we experience emotions is shaped by the culture we live in and the specific social setting they occur in [19]. Emotional processes are crucial in our interactions with others and we

all spend extensive amounts of time figuring out our own emotional reactions as well as interpreting those of others (sometimes highly individual reactions and expressions). The subtle nuances of our experiences that we want to express in interaction require interpretation and meaning-making, rather than crude simplifications. Designing for emotional communication that addresses bodily, cognitive and social aspects is therefore a true challenge.

From an interactional perspective, communication of emotions is not simply an information transfer problem; it is about physically and intellectually experiencing the whole range of emotions that make up a conversation. We name them *affective loop experiences*, experiences where it is not possible to separate the intellectual from sensual experiences, nor to single out what is my individual experience from the overall experience arising in a dialogue with a friend or in dialogue with a system.

The same non-reductionist stance we take towards emotion, we also take on designing for privacy and autonomy. The way privacy is protected or autonomy is preserved by systems like ours is by giving users tools to interpret and enact their emotional communication with others (or themselves). This can be through letting end-users decide what they want to share with one-another – making them create for the delicate balance that social relationships entail.

Finally, we will provide some orienting design concepts and methods for design and evaluation that help translate the interactional view into viable applications.

VALUES: PRIVACY AND AUTONOMY

In affective computing systems built from an informational view the aim is to infer users' emotions and then makes use of such information to support the user or improve communication between users. Privacy and autonomy are important concerns that are discussed in this community¹ [e.g. 31]. There are, of course, many other important values, such as ease of use, that need to be balanced against these in any design process, but here we focus on these two particular values since they are closely related to a non-reductionist position.

There is a range of applications in this area, let us just describe a few to illustrate the informational view on affective computing and how it relates to privacy and autonomy.

EmpathyBuddy is an email agent that looks at each sentence the user writes and uses affective user modelling based on cognitive science to extract the emotional value of each sentence [24]. *EmpathyBuddy* uses a common-sense filter to decide the goals and needs of the writer. This means that the user is only in indirect control of what emotions are displayed to the receiver – thereby infringing on both the autonomy and privacy of the user.

¹ See for example the work within the European project HUMAINE on ethics: emotion-research.net

Affective Learning is another domain where Picard and her group believe that affective computing can be applicable. It is well known that students' results can be improved with the right encouragement and support [21]. In the area of learning, Kort and colleagues have proposed an emotion model built on Russell's circumplex model of affect relating phases of learning to emotions [32]. The idea is to build a learning companion that keeps track of what emotional state the student is in and from that decides what help she needs. The perspective we take here is that such a system will not allow learners to decide for themselves how to organise their learning experience, thereby infringing on their autonomy.

Another application in the learning area from Picard's group is a leap chair with pressure sensors [26]. The chair classifies nine postures a student can have. The postures are related to affective states associated with a student's interest level. Similar to the other learning system, this system also pro-actively decides what the learner needs without empowering them to make their own decisions.

All of these applications regard emotion as something that can be measured, isolated and then used as a basis for how to make a system respond. This makes these kinds of systems potentially vulnerable to privacy protection issues. By that, we do not mean that the problem necessarily lies in what these systems store on the computer and whether that can be properly protected by various security solutions. Our concern lies on the level of what users may feel about systems that claims to know something about their emotional states, perhaps building profiles of them.

Overall, these systems may also threaten users autonomy since they do not hand over any control to the user, but instead decides what to communicate to others (be it friends or teachers or the system itself) about the end-user's emotional state.

Privacy as a Negotiated, Social and Cultural Process

Privacy is often referred to as "the right to be left alone" and in general that you are in control of what information is known about you to the public [5]. In affective computing applications, the system might be attempting to recognise and log users' affective processes, mood or perhaps even personality traits. This makes users' position vulnerable. Especially if users are not left in control of how this information about them is processed.

Initially we may, perhaps, naively perceive privacy as a matter of protecting end-users from violations of various kinds. But in the real, everyday problems that users typically encounter, protection turns out to be the wrong conceptual stance towards privacy. If privacy is seen as a problem of violations and need for protection, that also entails that there are definite boundaries for what a person should be sharing with others, that there are certain piece of information about ourselves that we own and need to protect. Another, alternative perspective, is to see privacy as nego-

tiation between two parties who are given tools that allow them to, on the fly, decide what to share and what not to share. In most Web 2.0 applications, there is always a set of such tools for negotiating closeness. You can see my Flickr-photos if I can see yours. In such systems, privacy is often coupled with *accountability*: I can see that you have tried to access my private information, and you know that I can see this. This allows for balancing the power between users – so-called social translucence [11].

There are various different definitions of privacy, but very few studies of how privacy actually unfolds as a process between people. A source of inspiration in this work is the analysis and perspective on privacy introduced by Palen and Dourish [28]. Building upon Altman, they reject the idea that privacy can be defined as a set concept from which we can derive a set of rules for when we have enough privacy and when there is too little. Instead, as it turns out, privacy is negotiated between parties, influenced by the culture they are in and regulated in interaction between people. They “outline a model of privacy as a dynamic, dialectic process” and show how this can be used to analyse a range of IT-applications.

As it turns out, people in different cultures are more or less sensitive to privacy violations. In a comparison between video surveillance in the US and in Sweden, it was found that the Swedish participants were significantly more privacy sensitive than the US participants [10]. Important to remember here is that our views on privacy will be shaped by the culture we live in. This in turn is influenced by the kinds of technologies we introduce into the society. If it is possible to have video surveillance everywhere without any special permission, then people will get used to this and behave differently in public spaces. In Sweden, this is not allowed, and people get worried if this principle is violated. In designing affective interactive applications, we have a great responsibility in deciding what can and should be known about users’ emotional processes and which negotiation and accountability mechanisms we offer.

Autonomy through Avoiding Reductionism

Autonomy refers to “a person’s ability to make independent choices”. Some proposed affective computing applications are *pro-active*, that is, they try to infer your needs without you telling them what they are, and then act before you know you have a need. Sometimes this can make a lot of sense, especially if the situation at hand happens in a context that is limited enough to be modelled in all its details and consequences. This is true for some time-critical tasks, such as flying an airplane in certain situations, or in health threatening situations, such as falling asleep when driving your car. Harper and colleagues argue that there are situations in which we want to be treated as machines, as we are aiming to behave like machines [15]. But in many situations, we are not predictable machines, nor do we want to be treated as such. For most applications, the tool-based view putting the user at core still holds: systems should be

designed as tools that users can make use of in ways that suit with their tasks, needs and creativity. Thus, the user needs to have more power and the system needs to be transparent and allow for various kinds of appropriations.

Overall, it may be that we should avoid creating applications that will gradually change our perception of what can and should be known about us. Statements such as “systems should address users emotional states so that they do not increase stress levels or fail to address users real needs” [29] carries an underlying assumption that it is possible to know about users’ emotional states. In a sense, we are through these systems conveying a reductionist idea – that it is possible to understand human thinking and sense-making if we only model enough of the signs and signals we transmit. Technology has the power to change our behaviours, our values and even the way we see ourselves, and thus a reductionist position enforcing a machine-like view on our minds and bodies even for those situations (such as learning, communicating with friends or reflecting on our own emotional processes) in which we should not be looked upon as predictable, manipulated machines.

THE INTERACTIONAL VIEW: DESIGN EXAMPLES

The interactional view sees emotions as processes spread over people and situations – constructed in a moment-to-moment fashion [3, 4]. Designs that are built from this perspective assume that the meaning of an emotional process is created by people and that affective interactive systems should be such that users are encouraged to negotiate these meanings themselves. It is not something a designer can design for entirely, but instead, is completed, *lived*, by the person experiencing.

Let us start with two examples on how to design from an interactional view where empowerment of users is put in the foreground, and where it is assumed that meaning is created by users. We shall then come back to and discuss what design elements make for an interactional view on affective interaction.

eMoto: a Communication Service

The first example deals with personal communication in general and communication of emotions in particular in a mobile setting – an extended SMS-service for the mobile phone. If we had deployed an informational view on this design problem, we might have tried to figure out how to increase the bandwidth between two users through recognising their emotional states, packaging them in some representation (e.g. as anthropomorphic faces) and then adding those representations to the messages and thereby not taking the user’s autonomy and privacy into account. Our starting point was instead to find an open-ended representation in which users could read their own interpretation and negotiate the meaning over time.

Instead, *eMoto* [34] was designed from an interactional view on communication between friends where we learn about each other’s emotional expressions step by step as

our friendships develops. It also draws upon the idea of an affective loop discussed in the introduction. In short, eMoto lets users send text messages between mobile phones, but in addition to text, the messages also have colourful and animated shapes in the background (see examples in Figure 1). The user writes the text-message and then chooses which expression to have in the background from a big palette of expressions mapped on a circle. The expressions are designed to convey emotional content along two axes: arousal and valence. For example, aggressive expressions have high arousal and negative valence and are portrayed as sharp, edgy shapes, in strong red colours, with quick sharp animated movements. Calm expressions have low arousal and positive valence which is portrayed as slow, billowing movements of big, connected shapes in calm blue-green colours.

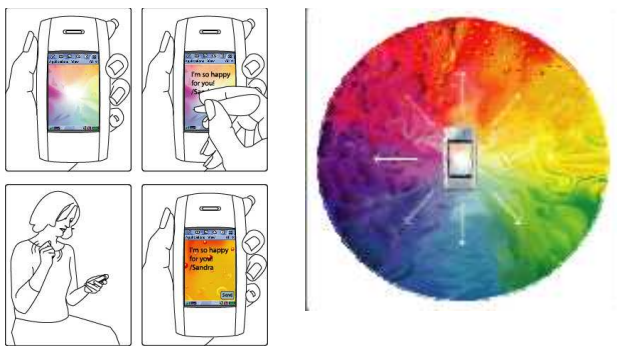


Figure 1. eMoto usage

To move around in the circle the user has to perform set of gestures using the stylus pen (that comes with some mobile phones) which we had extended with sensors that could pick up on pressure and shaking movements. Users are not limited to any specific set of gestures but are free to adapt their gesturing style according to their personal preferences, (see Figure 1). The pressure and shaking movements can act as a basis for most emotional gestures people do, a basis that allows users to build their own gestures on top of these general characteristics.

Studies of eMoto showed that the circle was not used in a simplistic one-emotion-one-expression manner, mapping emotions directly to what you are experiencing at the time of sending an emoto [34]. Instead the graphical expressions are appropriated and used innovatively to convey mixed emotions, empathy, irony, expectations on future experiences, surrounding environment (expressing the darkness of the night) and in general a mixture of their total embodied experiences of life and in particular, their friendship. We also saw that emotions are not singular states that exist within one person alone, but permeates the total situation, changing and drifting as a process between communicating friends. Allowing for this in the design means protecting the users' autonomy and privacy. The results confirm that emotional communication is something more than transferring

'information plus emotion' from one person to another in a truly interactional sense.

As one of the users in the study expressed it:

"I leave out things I think are implicit due to the colour... the advantage is that you don't have to write as much, it is like a body language. Like when you meet someone you don't say 'I'm sulky' or something like that, because that shows, I don't need to say that. And it's the same here, but here it's colour."

To make it clear: eMoto does not extract emotional information from users, but lets users directly express emotions to the system, a process over which they have total control. They can, for example, express emotions that they are not feeling. While this may seem like lying, it is in fact crucial in any communication situation in order to make human relations work, it is a social responsibility [1]. However, the affective loop of eMoto is set up to reinforce whatever emotion the user expresses by reacting to the expressive gestures performed by the user. Hence, in the end users may come to experience the emotion that they are expressing physically through shaking and pressing the extended stylus.

How much a user is willing to reveal to a friend through eMoto is something that the two friends negotiate and decide between themselves in a moment-to-moment fashion. A system that would automatically reveal one user's emotional state to the other would certainly overstep those boundaries sometimes (and sometimes not). It is not a once-and-for-all given state of the friendship between the two users.

Affective Diary: a Personal Logging System

The second example deals with personal logs in general and in our case a diary in particular. A diary provides a useful means to express inner thoughts and record experiences of past events. It also provides a resource for reflection. We wanted to create a diary that would draw upon sensor data picked up from users' bodies, allowing users to go back in time and see their own physical and emotional reactions. With an informational view on how to save memorabilia from users' daily emotional and bodily experiences, we might have ended up with a tool that would have classified users' emotions, placed them along a time line, telling the user what she had been experiencing during the day: at 14.38 on Wednesday you were happy at level 0.9.

But similar to the design of the eMoto system, we instead wanted to protect the users' autonomy and privacy by empowering for the diary writers themselves to make sense of the scraps and bits of data collected from their life.

In *Affective Diary* we wanted to explore reflection that goes beyond the purely intellectual experiences and aids users in remembering, and reflecting on, their embodied emotional experiences [22]. The aim was to provide users with material working as a bridge to the embodied emotional experience.

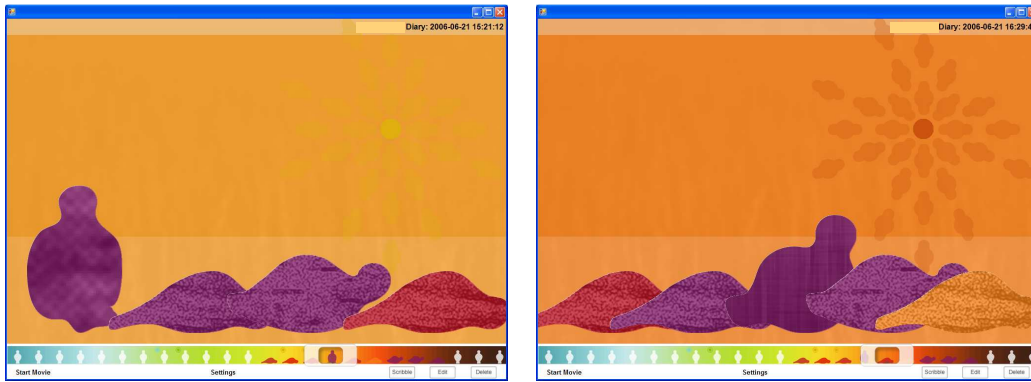


Figure 2 Erica's meeting with her boss

In short, Affective Diary works as follows: as a person starts her day she puts on the body sensor armband. During the day, the system collects time stamped sensor data picking up *movement* and *arousal* and various activities on the mobile phone: text messages sent and received, photographs taken, etc. Once the person is back at home she can transfer the logged data into her Affective Diary. The collected sensor data is presented as somewhat abstract ambiguously shaped and coloured characters placed along a timeline, see Figure 3.

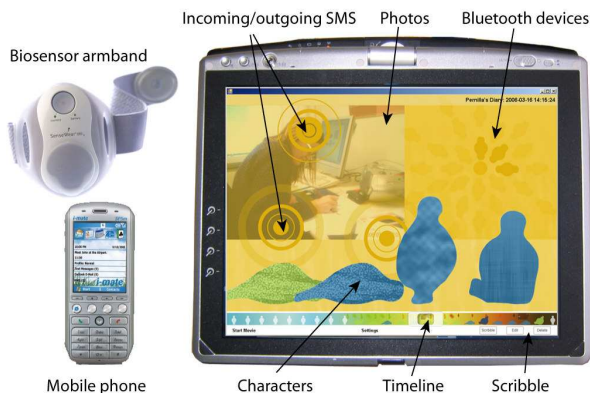


Figure 3. Affective Diary

Movement activity as registered by a pedometer in the sensor armband is represented by of how upright the character is. Arousal is represented by the colour of the character. Arousal is computed from a GSR-measurement (Galvanic Skin Response) – measures how much electricity the kin leads and aspects of this is considered to be related to emotional arousal. The mobile data appear in the diary at the times when you took them above the characters. To help users reflect on their activities and physical reactions the user can scribble diary-notes onto the diary or manipulate the photographs and other data.

An in-depth study with four users indicates that users were able to make sense of the diary material and relate it to different events in their life [35]. There was also evidence that they were able to recognise their bodily experiences through seeing the representation in the diary. By recognis-

ing and re-living some experiences (and on occasion and somewhat paradoxically by not recognising their own bodily reactions), they sometimes even learnt something about themselves that they did not know before. Two of our participants went even further and started to reflect on their lives and used Affective Diary to change aspects of themselves – in this way it became a learning tool, not because the system told them what to do, but because of their own reflection.

By using the diary, Erica, one of our participants discovered that certain events affected her mood, e.g. a meeting with her boss that made her very agitated, (see Figure 2). This was mirrored by the shape of the character in the diary and she could see that this mood persisted for a long time after the meeting. She says:

"We had a discussion about having vacation in July although I really didn't want to have vacation then, because I had nothing to do. That made me a little annoyed."

When Erica became aware of this she used it to change her own behaviour in stressful situations and even monitor how well she was doing. For instance on midsummer's eve, a holiday which usually made her very stressed, she had decided to take it easy. For that day/night the diary showed blue low energy shapes, which she interpreted as having succeeded in being calm and just enjoying the day.

HOW TO DESIGN FROM THE INTERACTIONAL VIEW?

Given these two examples, we can now come back to what we mean by the interactional view on design and discuss what it entails, and how it leads to empowerment for users, thereby protecting their privacy and autonomy.

Design Aims

First, the interactional view can be described as a set of design aims, as done by Boehner et al. [3]. Their ontological view on emotion is that it is "culturally grounded, dynamically experienced, and to some degree constructed in action and interaction". Emotions are created in a co-constructed, co-interpreted fashion. Hence the focus should be moved "from helping computers to better understand human emotion to helping people to understand and experi-

ence their own emotions”. Boehner et al provide the following list of design aims for an interactional approach:

1. The interactional approach recognizes affect as a social and cultural product
2. The interactional approach relies on and supports interpretive flexibility
3. The interactional approach avoids trying to formalize the unformalizable
4. The interactional approach supports an expanded range of communication acts
5. The interactional approach focuses on people using systems to experience and understand emotions
6. The interactional approach focuses on designing systems that stimulate reflection on and awareness of affect

To Boehner et al.’s set of aims, we want to add some of the physical, bodily experiences that an interaction with an affective interactive system might entail – as in the eMoto and Affective Diary examples above. The design ideal in both systems is to provide a means to represent embodied emotional experiences. The phenomenological definition of embodiment offers a way of explaining how we create meaning from our interactions with the world [9]. Our experience of the world depends on our human bodies, not only in a strict physical, biological way, through our *experiential body*, but also through our cultural bodies [12]. Fällman provides an example of a basic human activity, such as sitting on a chair. Since our physical bodies are erect, have two arms and legs, get tired, can bend forward at the hip and so on, chairs lend themselves to being sat on. However, it is only when we have acquired the skill of sitting we are able to do so. Thus we need to live and act in a culture where sitting on a chair makes sense.

Likewise, embodiment of emotions depends both on our experiential (physical) and cultural bodies. Emotions are experienced through the constitution of our experiential body. Primal emotions, such as fear or anger, make our autonomic nervous system react, change the hormonal levels in our body, change our facial expressions and focus our senses and cognition, preparing us for flight or fight behaviour [7]. Secondary or social emotions, such as shame or pride, crucial to our ability to maintain social relationships, also have associated corporeal processes affecting our body, facial expressions, body posture, and cognition [36]. But we do not make sense of our emotional reactions as biological processes nor are we predetermined to react in only one way to a particular circumstance. Emotion is a social and dynamic communication mechanism. We learn how and when certain emotions are appropriate, and we learn the appropriate expressions of emotions for different cultures, contexts and situations. The way we make sense of emotions is a combination of the experiential processes in our bodies and how emotions arise and are expressed in specific

situations in the world, in interaction with others, coloured by cultural practices that we have learnt. Designing for embodied representations of emotional experiences should thus ideally relate to and build upon both the experiential and cultural body.

We also take a slightly different stance towards design principle number three, “the interactional approach avoids trying to formalize the unformalizable”, in Boehner and colleagues list of principles. To avoid reductionist ways of accounting for subjective, aesthetic or indeed supple experiences, Boehner and colleagues aim to ‘protect’ these concepts by claiming that human experience is unique, interpretative and ineffable [2]. Such a position risks ‘mystifying’ human experience, closing it off as ineffable and thereby enclosing it to be beyond study and discussion. And even beyond making designs that are building on some kind of previous knowledge by the user or the designer without claiming the knowledge to be generalisable. While we wholeheartedly support the notion of unity of experience and support the idea of letting the magic of people’s lives remain unscathed, we do believe that it is possible to find a middle ground where we can actually speak about qualities of experiences and knowledge on how to design for them without reducing them to something less than the original. This does not in any way mean that the experiential strands, or qualities, are universal and the same for everyone. Instead they are subjective and experienced in their own way by each user. Only by collecting a number of stories from users can we begin to form some (practical) knowledge about how certain qualities are formed and how they relate to each other.

Other researchers have in the past attempted to describe practice and design knowledge without generalising into ‘scientifically proven’ formal rules or models of reality. They have tried to find ways of talking about design knowledge without abstracting away from the specific and unique. Schön, for example, argues that practitioners’ knowledge that arises from having to deal with specific experiences of specific cases/situations can be ‘demystified’ and reflected upon [33]. Through such a reflective process, practitioners gain knowledge that can best be described as a repertoire of design solutions. This repertoire can then be used, together with more generic ‘scientific’ knowledge, to address a specific case.

We look upon generalizations as, in many cases, domain-dependant orienting design concepts that designers pick up, transform and make use of in their own design work. They do not prescribe exactly what an interface should look like but instead makes the designer more sensitive to looking for certain kinds of solutions. They are not eternal truths about how something should be designed, but will be in dialogue with the current practices, de-facto standards and fashion trends. It should be possible to learn a design repertoire from good products that provides good grounds for an affective experience. Applying the obtained knowledge from such a design repertoire to the specific case at hand, is not

and cannot be a mechanistic process. A lived affective experience requires fine-tuning of exactly how we physically interact with the system, the timing of the responses from the system to user action needs to find its delicate balance, and addressing a range of other design issues. But still, such a design repertoire, slightly abstracted from the specific cases, will allow designers to pick up from and learn from each other [25].

Such a reflective process resulting in a design repertoire may help us approach the ineffable or unformalizable making if effable and generalisable without becoming reductionist or abstracting away from the unique situation and experience.

In summary, we would like to re-formulate two of the six items on the design list from Boehner et al:

1. The interactional approach recognizes affect as an embodied social, bodily and cultural product
3. The interactional approaches is non-reductionist

Beyond Dualism

As hinted throughout the text above, an interactional approach to design of affective systems requires a non-dualistic perspective. The experience aimed for is not solely a cognitive experience, but also a bodily one. In fact, it would be good if we could talk about it without separating it into mind and body as they are one. The experience cannot be separated into one intellectual process and one emotional. Nor can emotion be separated from its social context. Already Dewey (and of course many others) argued against such a dualistic perspective when it comes to experiences, for example, in understanding the role of emotion in perception:

“There is, therefore, no such thing in perception as seeing or hearing plus emotion. The perceived object or scene is emotionally pervaded throughout.” [8] (p. 55)

If we attempt to define a lived emotional experience in dualistic terms, we will surely fail, but with a perspective where man is seen as a whole, both body and mind, both individual and part of the world, the gulf between our interpretative experiences and what can/cannot be studied will not be as problematic. The two systems discussed above allow for a richer expressiveness and involves more of our senses for experiencing emotions, making them a vital part of the communication/reflection.

In searching for theories that include the human body, the feminist movement can be a source of inspiration as it has had to take a new perspective on the body and the differences between different bodies. For example, Elisabeth Grosz is interested in the specific constitution of the human body (and thereby also the difference between the male and female body) and claims that it cannot be overlooked if we want to understand the human condition. She sees the body as being ‘completed’ by culture and social experiences:

“[...] as an essential internal condition of human bodies, a consequence of perhaps their organic openness to cultural completion, bodies must take the social order as their productive nucleus. Part of their own ‘nature’ is an organic or ontological ‘incompleteness’ or lack of finality, an amenability to social completion, social ordering and organisation.” [14] (p. xi)

The emotional communication between users of eMoto or in the reflective process of the user of Affective Diary also clearly shows how emotion cannot be separated from the totality of the social context, previous experiences, qualities of the friendships, work, and life in general. In both systems (eMoto and Affective Diary), the empowerment-stance relates not only to users’ cognitive processing, but also to what signs and signals their bodies transmit – otherwise the dualism-chasm would not be bridged. Our bodily experiences are part of, not separate from, our cognitive and social experiences.

DESIGN SOLUTIONS

Translating the six interactional design aims into actual designed systems is of course a difficult process, but there are some lessons learnt on how to do it. We can be guided by, for example, design elements such as:

- Designing open familiar surfaces that can be appropriated by users [16, 34]
- Leaving the interpretation to the user through a balanced ambiguous design elements [13]
- Involving users in affective loop experiences [34]

Let us just briefly explain each of these and how they have similar purposes in leaving open for users’ own creativity and ability to negotiate meaning.

Open Familiar Surfaces

To allow users to interpret and express their own, or others’, emotional expressions, it may be important to leave certain surfaces in the interface ‘open’ to users so that they can fill them with their own meaning and patterns of behaviour. But such surfaces might be very hard to understand unless there are elements in them that make them familiar to us. Thus, an alternative to very ambiguous designs are those building on design elements that feel familiar to people, but not entirely ready-made for interpretation and thereby ‘closed’ [16].

With Affective Diary and eMoto, we have attempted to integrate our ideas of bodily experience with the interactional approach. We have explored designs that interact with users’ physical bodies but leave room for interpretation. The aim is to move from a dualistic perspective on emotion and constructively allow users to be involved and make sense of the interaction physically, cognitively and socially, as part of the total context. Technically, we have considered how this can be done through technologies that sense our corporeal, physical and sensual bodies. Our position is that such sensed data should be represented in ways that feel emotionally familiar but can be appropriated by

users [16]. For instance, there are systems that capture users' facial expressions or body postures in real-time and represent emotional states using avatars or robot behaviours [23, 30]. A more abstract design that builds on the dynamics of emotions as experienced by our physical bodies is adopted by the eMoto system. Here colours, shapes and animations attempt to mirror users' physical gestures addressing their inner experience of emotions [35]. The interpretation of those colours, shapes and animations relate to our bodily experiences – they feel familiar when we perform the gestures with the stylus – but they do not have a given meaning, mapping emotions in a one-to-one fashion to certain colours. Indeed, in our study we saw some users choosing green colours and soft animations to convey happiness, others used the red colours with bubbly animations that we intended to be happy expressions. And still they understood each other because they were friends.

Finding the right degree of openness when it comes to possible interpretations of the design or possibilities to shape the system is a tough challenge for designers. A too 'closed' design leaves little room for interpretation and appropriation while a too 'open' design runs the risk of becoming meaningless.

Importantly, the approaches that have based their designs familiarity do not discount the learning that is needed to interpret and interact with their systems. It simply means that once they start interacting with the systems, they can relate to their own physical, bodily practices and emotional reactions in order to make sense of the system.

Balanced Ambiguity

Most designers would probably see ambiguity as a dilemma for design. Gaver and colleagues, however, looks upon it as *“a resource for design that can be used to encourage close personal engagement”* [13]. They argue that in an ambiguous situation people are forced to get involved and decide upon their own interpretation of what is happening.

As Gaver and colleagues point out, the everyday world in general is inherently ambiguous and most things will have multiple meanings depending upon how we see them. This has been exploited in arts where ambiguous meanings contribute to the aesthetic experience. Gaver and colleagues created a range of systems where the meaning of the IT-artefact was not obvious. Their goal was to be evocative rather than didactic and mysterious rather than obvious. Through this attitude, they broke with the tradition in HCI to rely entirely on understanding as the basis for interaction. Instead, their focus was on the interpretative relationship between people and artefacts. Ambiguous design does not mean fuzzy or inconsistent design – simply that it may give rise to multiple interpretations. This is what the characters in the Affective Diary system allows for and what the colours, shapes and animations in eMoto portray, a surface of balanced ambiguity, where the openness is there for multiple interpretations to take place, but balanced so they do not seem random.

Affective Loop

In some cases, the affective interaction systems have been designed not only to 'read' off the body and display representations, but also to encourage users to act – make gestures, new postures, etc. In what has been referred to as the affective loop [35] subsequent actions are meant to invoke further reactions and emotional experiences. This loop can be in real-time with immediate feedback and less reflection, as in eMoto, or a long-term process that invokes a deeper reflection and more lasting change, as in Affective Diary.

To clarify what we intend by an affective loop we see it as an interaction process where:

- the user first expresses her emotions through some physical interaction involving the body, for example, through gestures or manipulations of an artefact,
- the system (or another user through the system) then responds through generating affective expression, using for example, colours, animations, and haptics,
- this in turn affects the user making the user respond and step-by-step feel more and more involved with the system

This means that the system is not trying to infer users' emotional states, but instead involve users in emotional interactional process. Users may then choose to be involved or not – it is up to them to make the interaction unfold in ways that make sense to them. The system is only staging the scene for the activity.

Methods for Design and Evaluation

An interactional approach also entails a commitment to a set of design and evaluation methods that in turn allow for open-ended interpretation of emotion processes as interactional over people, culture, and settings.

In our experience, to find the applications and situations in which there is a potential for these kinds of design solutions to make sense – where a familiarity interpretation process can arise in and from the interaction – we need to look for the everyday experiences where the presence of others, their choices and their meaning-making processes are crucial to our own sense-making.

It can therefore be very important to study the everyday practices and everyday physical, bodily, encounters we have with the world [9, 12]. But another, some-times equally fruitful path is to instead start from the design material: the technology available to us. The properties of the material itself raise a number of limiting conditions and possible openings. Only when experiencing the possibilities that this gives and how it feels when interacting with it, we can really see what makes sense [17].

Once a system is designed, it needs to be evaluated. In a paper by Kaye and Sengers, [20], the history of evaluation in HCI is discussed. Their perspective is that today, evaluations of experience-focused HCI are typically more open-

ended and often encourage multiple, perhaps conflicting interpretations. This is the case with, for example, the Sensual Evaluation Instrument [18]. The aim is not to classify users' reactions into a pre-set list of emotion labels, but instead allow users to express their experiences through manipulation of a set of ambiguously designed clay-figurines with different body-like shapes, as they are interacting with the system being evaluated. This can be contrasted with methods such as Nielsen's heuristic evaluation [27] where it is assumed that there are bugs in the interface that can be found, diagnosed and fixed.

Thus, the methods that will lead to a system design that encourages an interactional perspective on design of affective interaction need to be founded on the same interpretative, open-ended, multiple interpretations basis. Putting experience and interpretation at core, has to penetrate the whole design cycle – not only the final application.

CONCLUSIONS

The main thesis of this paper is that it is possible to address values such as privacy and autonomy through designing affective computing systems from an interactional perspective and that this interactional perspective will lead to empowerment for end-users to create meaning and alter the system over time to fit with their needs, ideas, hopes and dreams. Through handing over open-ended, ambiguous, yet familiar, tools to users that they may use as a basis to make sense of themselves and their interaction with one-another, we provide them with power over their own data and the interpretation of it.

The underlying theoretical perspective is that of embodied interaction [9]. From studying social and affective communication practice as it unfolds between people in the world, we gain the basis for designing systems and artefacts that can serve as extensions of ourselves in interacting with others and ourselves. Our viewpoint is that emotions are embodied processes that we are deeply involved with and that cannot be separated from the context in which they are experienced [19].

Leaving some surfaces open in the design, or in general providing a tool-based view on affective computing does not mean that we design tools that are empty to start with and where the whole content is given by the user. Instead, we try to design the systems based on our daily social, emotional and bodily interactions with the world, making them feel familiar to users. But the applications we build will not make sense or have any meaning until users pick them and make them parts of their own practice, their own familiarity with their emotional, social, and bodily encounters with themselves and the world. Through this process, the interpretative powers is left in the hands of the users, allowing for privacy and autonomy of, perhaps, a different ilk to the traditional perspective on these values as something that the users own and need to protect.

In summary, the way privacy is protected by systems like this is by handing over the power of the tools to the end-users to negotiate what they want to share with one-another – making them create for the delicate balance that social relationships entail. We also privilege users to be the ones who interpret and create meaning from the emotional aspects of the system. They may even be allowed to tinker with and alter the emotional representations over time.

Apart from making users negotiate privacy with one-another this system design perspective also respects users' autonomy and ability to know themselves what they want to do through the system. Obviously, this does not mean that we can set aside demands on security solutions in the system or be watchful about introducing bias into the system design that will force users to behave in certain ways in order to comply with the design. But we do place the power in the hands of the end-users instead of in the hands of designers of the system.

ACKNOWLEDGMENTS

We thank the European Union for the funding of researchers dedicated to this project through the HUMAINE project.

Thanks also to those affective presence researchers who inform and inspire our work: Phoebe Sengers, Bill Gaver, Katherine Isbister, Michael Mateas, Geri Gay, Kirsten Boehner and Jofish Kaye, and to the anonymous reviewers of this paper.

REFERENCES

1. Aoki, P. M., Woodruff, A. (2005). Making space for stories: ambiguity in the design of personal communication systems, Proceedings of the SIGCHI conference on Human factors in computing systems, Pages 181 –190, ACM Press.
2. Boehner, K. Interfaces with the ineffable, (2006). Unpublished Thesis Manuscript, LB41.3 2006 B644, Mann Library, Cornell University, USA.
3. Boehner, K., DePaula, R., Dourish, P., and Sengers P. (2005). Affect: From Information to Interaction. Critical computing Conference 2005, Århus, Denmark.
4. Boehner, K., DePaula, R., Dourish, P., and Sengers P. (2007). How Emotion Is Made and Measured, International Journal of Human-Computer Studies, Vol. 65, Issue 4, Pp. 275-291.
5. Bylund, M. (2005). A Design Rationale for Pervasive Computing – User Experience, Contextual Design, and Technical Requirements, Unpublished Thesis Manuscript, Royal Institute of Technology, Stockholm
6. Damasio, A. R. (1994). Descartes' Error: Emotion, Reason and the Human Brain, Grosset/Putnam, New York.
7. Davidson, R. J., Pizzagalli, D., Nitschke, J. B., Kalin, N. H. (2003). Parsing the subcomponents of emotion and disorders of emotion: perspectives from affective neuro-

- science, In *Handbook of Affective Sciences*, Davidson, R. J., Scherer, K. R., Goldsmith, H. H. (eds.).
8. Dewey, J. (1934). *Art as Experience*, Perigee, USA
 9. Dourish, P. (2001). *Where the Action Is: The Foundations of Embodied Interaction*. Cambridge: MIT Press.
 10. Eidmar, L. and Sallmander Prien, C. (2005). Who is watching you? A study on people's views on privacy in public places, Unpublished MSc-thesis, Dept. of Computer and Systems Sciences, SU/KTH, 05-79.
 11. Erickson, T. and Kellogg, W. A. (2000). Social translucence: an approach to designing systems that support social processes, *ACM Transactions on Computer-Human Interaction*, Vol. 7, No. 1, Special issue on human-computer interaction in the new millennium, March 2000, Pages 59–83.
 12. Fällman, D. (2003). In *Romance with the Materials of Mobile Interaction: A Phenomenological Approach to the Design of Mobile Information Technology*, Doctoral Thesis, ISSN 1401-4572, RR.03-04, ISBN 91-7305-578-6, Umeå University, Sweden: Larsson & Co:s Tryckeri.
 13. Gaver, W.W., Beaver J. and Benford, S. (2003). Ambiguity as a Resource for Design, *Proceedings of the conference on Human factors in computing systems (CHI'03)*, Ft. Lauderdale, Florida, USA.
 14. Grosz, E. (1994). *Volatile Bodies: Toward a corporeal feminism*, Indiana University Press.
 15. Harper, R. Randall, D. Smyth, N. Evans, C. Heledd, L. And Moore, R. (2007). Thanks for the memory, *Interact: HCI 2007*, Lancaster, Sept.
 16. Höök, Kristina (2006). Designing Familiar Open Surfaces, In *Proceedings of NordiCHI 2006 Oslo, Norway*, October 2006, pp. 242 – 251, ACM press.
 17. Iacucci, G., Iacucci, C. and Kuutti, K. (2002). Imagining and experiencing in design, the role of performances, *Proc. of the second Nordic conference on Human-computer interaction*, Aarhus, Denmark, pp. 167 – 176.
 18. Isbister, K, Höök, K., Laaksolahti, J., and Sharp, M. (2007). The Sensual Evaluation Instrument: Developing a Trans-Cultural Self-Report Measure of Affect, *IJHCS*, vol. 65, issue 4, pp. 315 – 328, April 2007.
 19. Katz, J. (1999).. *How Emotions Work*. Chicago: University of Chicago Press
 20. Kaye, J., Sengers, P. (2007). The Evolution of Evaluation, *alt.chi (not archival) CHI 2007*, San Jose CA.
 21. Kort, B., Reilly R. and Picard R.W. (2001). An Affective Model of Interplay Between Emotions and Learning: Reengineering Educational Pedagogy-Building a Learning Companion, In *Proceedings of International Conference on Advanced Learning Technologies (ICALT 2001)*, Madison, WI.
 22. Lindström, M., Ståhl, A., Höök, K., Sundström, P., Laaksolathi, J., Combetto, M., Taylor, A. and Bresin, R. (2006). *Affective Diary - Designing for Bodily Expressiveness and Self-Reflection*, In *Extended abstract CHI'06*, Montréal, Québec, Canada, ACM Press.
 23. Lisetti, C., Nasoz, F., LeRouge, C., Ozyer, O., and Alvarez, K., (2003). Developing multimodal intelligent affective interfaces for tele-home health care, *International Journal of Human-Computer Studies*, Volume 59, Issues 1-2 , July 2003, pp. 245-255
 24. Liu, H., Selker, T., and Lieberman, H. (2003). Visualizing the Affective Structure of a Text Document. *Extended Abstracts CHI 2003*, Ft. Lauderdale, ACM Press.
 25. Löwgren, J. (2007). Inspirational patterns for embodied interaction. *Journal of Knowledge, Technology & Policy* 20(3).
 26. Mota, S. and Picard, R. W. (2003). Automated Posture Analysis for Detecting Learner's Interest Level, *Conference on Computer Vision and Pattern Recognition Workshop*, Vol. 5, p. 49.
 27. Nielsen, J. (1992). Finding Usability Problems through Heuristic Evaluation. In *Human Factors In Computing Systems CHI'92*, pp.373-80. New York ACM Press.
 28. Palen, L. and Dourish, P. (2003). Unpacking "privacy" for a networked world, *CHI 2003*, Ft. Lauderdale Florida, USA Pages: 129 – 136.
 29. Picard, R. (1997). *Affective Computing*, MIT Press, Cambridge, MA, USA.
 30. Psik, T., Matkovi'c, K., Sainitzer, R., Petta, P., and Szalavari, Z., (2003). The invisible person: advanced interaction using an embedded interface, *Proc. workshop on Virtual environments*. Pp. 29 – 37, ACM Press.
 31. Reynolds, C. And Picard, R. (2004). Affective sensors, privacy, and ethical contracts, In *CHI '04 extended abstracts on Human factors in computing systems*, Vienna, Austria, pp. 1103 – 1106, ACM Press.
 32. Russell, J.A. (1980). Circumplex Model of Affect, *Journal of Personality and Social Psychology*, Vol. 39, No. 6, 1161-1178, American Psychological Association.
 33. Schön, D. A. (1983). *The Reflective Practitioner: How professionals think in action*. London: Temple Smith.
 34. Sundström, P., Ståhl, A., Höök, K. (2007). In Situ Informants Exploring an emotional Mobile Messaging System in Their Everyday Practice, In a special issue of *IJHCS on Evaluating Affective Interfaces*, vol. 65, issue 4, pp. 388 – 403, April 2007.
 35. Ståhl, A., Höök, K., Svensson, M. Taylor, A. and Combetto, M. (submitted). *Experiencing the Affective Diary*.
 36. Tangney, J. P. and Fischer, K. W. (1995). *Self-conscious emotions: The psychology of shame, guilt, embarrassment, and pride*, NY: Guilford.